

## Introduction

EPA Region 10 developed this workbook to evaluate the need for water quality-based effluent limits (WQBELs) and to calculate effluent limits based on EPA's Technical Support Document for Water Quality-based Toxics Control. The worksheet is intended to be used for NPDES permitting in Idaho and utilizes Idaho's Water Quality Standards.

## Instructions for Using RPA Workbook to evaluate WQBELs

### Step 1

Enter plant design flow and critical river flows in "RP and Limits" worksheet. Optional seasonal critical flows may be entered. If facility has model dilution factors, enter dilution factors on the "RP and Limits" in Rows 49-51.

dFlow may be used to calculate critical flows using USGS river flow data.

BASINS dFlow link <http://water.epa.gov/scitech/datatit/models/basins/download.cfm>

USGS Link <http://waterdata.usgs.gov/id/nwis>

### Step 2

Enter ambient river hardness in "WQ Criteria" worksheet. Optional effluent hardness may be entered if mixed hardness is used. Hardness data not needed if not effluent metals data is available.

Ambient receiving water data available at some USGS stations.

USGS Link <http://nwis.waterdata.usgs.gov/id/nwis/qwdata>

### Step 3

Enter Pollutants of Concern in "RP and Limits" worksheet. Identify POCs based on pollutants known to present in the effluent. For ammonia, temperature and pH data must be entered to calculate ammonia criteria.

Change data on "Ammonia Criteria" worksheet if different from default as noted on "RP and Limits" worksheet.

Enter data in rows with "red" text where applicable.

## Notes

Green Tabbed Removed for External Version

Worksheets

Red Tabbed Primary worksheet for Effluent Limits calculations

Worksheet

## References

### Link to State RPA Workbooks

Alaska Not yet posted

Idaho Not yet posted

Oregon [RPA Calculation Workbook, Domestic, Revision 3.4](#)

[RPA Calculation Workbook, Industrial, Revision 3.6](#)

Washington [PermitCalc Workbook](#)

### **Link to State Water Quality Standards**

Alaska <http://dec.alaska.gov/water/wqsar/wqs/>  
Idaho <http://adminrules.idaho.gov/rules/current/58/0102.pdf>  
Oregon [http://arcweb.sos.state.or.us/pages/rules/oars\\_300/oar\\_340/340\\_041.html](http://arcweb.sos.state.or.us/pages/rules/oars_300/oar_340/340_041.html)  
Washington <http://apps.leg.wa.gov/WAC/default.aspx?cite=173>  
EPA National <http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm>  
Recommended  
Water Quality  
Criteria

### **Technical Assistance**

Karen Burgess [burgess.karen@epa.gov](mailto:burgess.karen@epa.gov)

Date	Worksheet	Cell	Content	Description	Revised by
2/6/2014	NH3-fresh			Removed old Ecology formula for unionized ammonia	K. Burgess
3/17/2014	Reasonable Pot			Formatting changes to address Excel 2013	K. Burgess
3/20/2014	Reasonable Pot			reversed rows 56 and 57. Added if statement to row 57 to address appropriate use of $n \geq 4$ , or $n=30$ (ammonia).	K. Burgess
4/18/2014	Reasonable Pot			Major changes to remove all conditional formatting and replace with formula	K. Burgess
4/30/2014	RP Multiplier Table			Added new table to calculate RP Multiplier or generate multiplier table based on variable confidence interval and probability basis.	K. Burgess
5/6/2014	RP and Limits			Table Renamed, Ammonia criteria formula low and high flow corrected	K. Burgess
5/27/2014	WQ Criteria			Removed "--" from criteria worksheet, added clarifying text.	K. Burgess
5/27/2014	RP and Limits			added iferror statement to rows 33-27 to indicate DF only if n is a number.	K. Burgess
7/21/2014	Ammonia Criteria			Fixed cell referenced using cell names	K. Burgess
7/21/2014	RP and Limits			Change design flow to cell name in loading formula	K. Burgess
7/21/2014	Criteria			Resorted alpha to ensure lookup in RP and Limits functions properly.	K. Burgess
7/23/2014	Plant Data and DF			Added instructions in column G	K. Burgess
7/23/2014	RP and Limits			Added some instructions in col R and corrected circular reference in cell D13.	K. Burgess
7/23/2014	Ammonia Criteria 2013- Acute			Worksheet added for calculating 2013 acute ammonia criteria	K. Burgess
7/24/2014	Ammonia Criteria - 2013 Chronic			Worksheet for added calculating 2013 chronic ammonia criteria	K. Burgess
10/7/2014	Plant Data and DF			Changed HH percentage of river flow for dilution from 100% to 25% based on Consistency Meeting discussion.	K. Burgess
10/7/2014	RP and Limits			Added note in column S, rows 24-25. "If mixing zone is authorized use 95% percentile of receiving water pH and temperature. If mixing zone is not authorized, consider using 95% percentile of effluent pH and temperature, as appropriate."	K. Burgess
10/27/2014	WQ Criteria			The mercury aquatic life criteria corrected to 2.1 ug/L acute and 0.012 ug/L chronic.	K. Burgess
11/12/2014	RP Multiplier Table			"RP Multiplier" worksheet renamed to "TSD Factor Calc"	K. Burgess
11/12/2014	TSD Factors Calc			Added calculations for TSD multipliers from Tables 3-1, 3-2, 5-1, 5-2, 5-3 and adapted 5-3 (AWL). Use for calculating limits with WLA or $WLA=LTA$ . Use to double check calculations when calculating RPA and limits multipliers.	K. Burgess

11/12/2014 Instruction			Added Instructions worksheet to include instructions and references for workbook.	K. Burgess
11/12/2014 RP and Limits			Changed formulas for LTA to allow for variable % probability basis.	K. Burgess
11/12/2014 RP and Limits			Clarified formula notations.	K. Burgess
11/12/2014 Multiple			Green-tabbed worksheets will be removed for external version.	K. Burgess
11/12/2014 Multiple			Locked cells on various worksheet to protect changes to external version when workbook is protected.	K. Burgess
12/9/2014 WQ Criteria			Changes Total Ammonia Nitrogen to Ammonia Nitrogen, Total to find more easily on alphabetized list.	K. Burgess
12/9/2014 RP and Limits			Change formula in rows 85, 86, 92, 93 so that numbers do not appear unless RP=yes.	K. Burgess
12/9/2014 References			Worksheet name changed, introduction added. Links to references added.	K. Burgess
12/9/2014 WQ Criteria			cell B5, added data validation only allows values 10-400 and alert for Cadmium min. hardness of 10.	K. Burgess
12/9/2014 Plant Data and DF			Changed heading rows 6,22,38	K. Burgess
2/1/2016 Plant Data and DF			Revised worksheet to be independent of RP and Limits	K. Burgess
2/1/2016 RP and Limits			Added River critical flows and DF	K. Burgess
2/1/2016 RP and Limits			Added variable percent river flow	K. Burgess
2/1/2016 RP and Limits			Misc formula changes throughout	K. Burgess
2/1/2016 WQ Criteria			Added Note following pollutant name for ID Toxic BiOp	K. Burgess
2/12/2016 RP and Limits			corrected formula in I48 through S to used chronic dilution. Had incorrectly carried over 30B3 dilution into formula	K. Burgess
2/24/2016 RP and Limits			Formatting changes to Critical River flow text	K. Burgess
4/11/2016 WQ Criteria			pentachlorophenol AL criterion based on a pH, correct formula added.	K. Burgess
4/18/2017 RP and Limits	D56	=exp(zσ-0.5σ <sup>2</sup> )/exp[ norms inv(Pn)σ-0.5σ <sup>2</sup> ], where probability basis =	Added sigma to formula after Pn	
4/18/2017 RP and Limits	I59-S59	"IFERROR(IF(I40>0,((I31*I56*I40)+I33*(I48-1))/I48,(((I31*I56)+I33*(I48-1))/I48)),"--")"	Corrected formula i	

Filters can be used to hide sections from view. Hide unneeded columns. Do not remove. For additional columns, r-click col K, insert column(s) here, select J28:J101, grab "x" at lower-right corner to drag to copy.

**Instructions or use:**  
 (1) Enter facility design flow and critical river flows. To enter customized DF by Pollutants use Rows 47-51.  
 (2) Enter hardness information on WQ Criteria to calculating hardness-dependent metals criteria. Only receiving water hardness is required or if using mixed hardness enter effluent hardness.  
 (3) Enter data in empty cells below. "-" or "" indicates cell entry not needed.  
 (4) Use pull-down menus to select POC. Add or hide columns as needed for additional/fewer pollutants.  
 (5) Hide rows that calculate limits if they don't apply (or use filter on top of Column A).  
 (6) Adjust significant digits and column widths as needed for customize presentation of data. Customize "NOTE" areas as needed to explain assumptions.  
 (7) Use cursor to select worksheet area below. Select copy and then paste table into text sheet as picture.

**Instruction and Notes**

**Reasonable Potential Analysis (RPA) and Water Quality Effluent Limit (WQBEL) Calculations**

Facility Name: \_\_\_\_\_  
 Facility Flow (mgd): \_\_\_\_\_  
 Facility Flow (cfs): \_\_\_\_\_ 0.00

Critical River Flows	Annual Crit. Flows	Seasonal Low Flow	Seasonal High Flow	Annual Crit. Flows											
Aquatic Life - Acute Criteria - Criterion Max. Concentration (CMC)	1010														
Aquatic Life - Chronic Criteria - Criterion Continuous Concentration (CCC)	7010 or 4B3														
Ammonia	30B3/30Q10 (seasonal)														
Human Health - Non-Carcinogen	30Q5														
Human Health - carcinogen	Harmonic Mean Flow														

Receiving Water Data  
 Hardness, as mg/L CaCO<sub>3</sub> = 100 mg/L  
 Temperature, °C \_\_\_\_\_  
 pH, S.U. \_\_\_\_\_

Notes:  
 5<sup>th</sup> % at critical flows  
 95<sup>th</sup> percentile  
 95<sup>th</sup> percentile

Enter Facility Name  
 Enter Facility Design Flow in Units of MGD

Data transfers from "Plant Data and DF" worksheet or dilution factor data may be input directly if river flow are not used or DF modeling numbers are available.  
 Use of columns G and H to evaluate ammonia on seasonal basis during low and high flow periods.

Hardness needed only if effluent metals data is available for which to evaluate reasonable potential. If metals monitoring will be required, consider monitoring ambient hardness for next permit renewal.  
 If mixing zone is authorized enter 95<sup>th</sup> percentile of receiving water temperature. If no MZ, consider using 95<sup>th</sup> effluent T is appropriate.  
 If mixing zone is authorized enter 95<sup>th</sup> percentile of receiving water pH. If no MZ, consider using 95<sup>th</sup> effluent pH is appropriate.

**Pollutants of Concern**

AMMONIA default: cold water, fish early life stages present	AMMONIA default: cold water, fish early life stages present	AMMONIA default: cold water, fish early life stages present	CHLORINE (Total Residual)
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Effluent Data	Number of Samples in Data Set (n) Coefficient of Variation (CV) = Std. Dev./Mean (default CV = 0.6) Effluent Concentration, µg/L (Max. or 95 <sup>th</sup> Percentile) (C <sub>e</sub> ) Calculated 95 <sup>th</sup> % Effluent Conc. (when >=10), Human Health Only														
Receiving Water Data	90 <sup>th</sup> Percentile Conc., µg/L (C <sub>r</sub> ) Geometric Mean, µg/L, Human Health Criteria Only														
Applicable Water Quality Criteria	Aquatic Life Criteria, µg/L Acute Chronic														
	Human Health Water and Organism, µg/L Human Health, Organism Only, µg/L														
	Metals Criteria Translator, decimal (or default use Conversion Factor)	Acute Chronic													
	Carcinogen (YN), Human Health Criteria Only														
Percent River Flow Default Value = 25%	Aquatic Life - Acute	1010													
	Aquatic Life - Chronic	7010 or 4B3													
	Ammonia	30B3 or 30Q10													
	Human Health - Non-Carcinogen	30Q5													
Calculated Dilution Factors (DF) (or enter Modeled DFs)	Human Health - carcinogen	Harmonic Mean													
	Aquatic Life - Acute	1010													
	Aquatic Life - Chronic	7010 or 4B3													
	Ammonia - Chronic	30B3 or 30Q10													

Enter pollutants using pull-down menus in header row.  
 To help read drop-down menu, widen column width.

This is the number of effluent samples in the set from which the Maximum or 95<sup>th</sup> Percentile Concentration value was taken.  
 Use default CV of 0.6 when sample size is <20 (<10 for Human Health). Calculate CV from data set as Standard Deviation divided by Mean whenever sample size is >20 (>10 for Human Health).  
 Enter maximum concentration when n<20 for aquatic life or n<10 for human health. When n>20 for aquatic life, enter calculated 95<sup>th</sup> percentile value.  
 Enter 50<sup>th</sup> Percentile value for Human Health when n>10.  
 90<sup>th</sup> percentile of critical season ambient data; used for Aquatic Life Calculations.  
 Geometric mean of ambient data for human health parameters.

For impaired water, a mixing zone may not be authorized. If end of pipe limits must be met, enter 1.0 for the dilution factor.

**Aquatic Life Reasonable Potential Analysis**

p = σ<sup>2</sup> \* n(CV<sup>2</sup> + 1)  
 P<sub>c</sub> = 1 - (1 - confidence level)<sup>n</sup>, where confidence level = 99%  
 Multiplier (TSD p. 57) = exp(2.326 \* 0.5 \* exp(nvnorm(P<sub>c</sub>, 0 - 0.5 \* σ<sup>2</sup>))) where 99%  
 Statistically projected critical discharge concentration (C<sub>d</sub>)  
 Predicted max. conc. (µg/L) at Edge-of-Mixing Zone  
 Acute  
 Chronic  
 (note: for metals, concentration as translated using conversion factor as translator)  
 Reasonable Potential to exceed Aquatic Life Criteria

<http://nepis.epa.gov/EPA/PURL.cgi?Dockey=20033889.txt>

**Aquatic Life Effluent Limit Calculation**

Number of Compliance Samples Expected per month (n)  
 n used to calculate AML (if chronic is limiting then use min=4 or for ammonia min=30)  
 LTA Coeff. Var. (CV), decimal (Use CV of data set or default = 0.6)  
 Permit Limit Coeff. Var. (CV), decimal (Use CV from data set or default = 0.6)  
 Acute WLA, µg/L C<sub>a</sub> = (Acute Criteria x MZ<sub>1</sub>) / CV<sub>a</sub> (MZ<sub>1</sub>=1)  
 Chronic WLA, µg/L C<sub>c</sub> = (Chronic Criteria x MZ<sub>2</sub>) / CV<sub>c</sub> (MZ<sub>2</sub>=1)  
 Long Term Ave (LTA), µg/L WLA<sub>a</sub> x exp(0.5σ<sup>2</sup>z<sub>0</sub>), Acute 99%  
 [99% % occurrence prob.] WLA<sub>a</sub> x exp(0.5σ<sup>2</sup>z<sub>0</sub>), ammonia n=30, Chronic 99%  
 Limiting LTA, µg/L used as basis for limits calculation  
 Applicable Metals Criteria Translator (metals limits as total recoverable)  
 Average Monthly Limit (AML), µg/L, where % occurrence prob = 95%  
 Maximum Daily Limit (MDL), µg/L, where % occurrence prob = 99%  
 Average Monthly Limit (AML), mg/L  
 Maximum Daily Limit (MDL), mg/L  
 Average Monthly Limit (AML), lb/day  
 Maximum Daily Limit (MDL), lb/day

Enter the proposed number of monthly compliance samples if limit is necessary.  
 Refer to TSD section 5.5.3  
 Enter default CV of 0.6. If CV was calculated for existing effluent data, use calculated value.

Note: formula for sigma divide by 30 for ammonia

This row determines if a translator is necessary in calculating the limits and whether to use the acute or chronic translator. A one means no effective translator.

**Human Health Reasonable Potential Analysis**

p = σ<sup>2</sup> \* n(CV<sup>2</sup> + 1)  
 P<sub>c</sub> = 1 - (1 - confidence level)<sup>n</sup>, where confidence level = 95%  
 Multiplier = exp(2.326 \* 0.5 \* exp(nvnorm(P<sub>c</sub>, 0 - 0.5 \* σ<sup>2</sup>))), prob. = 50%  
 Dilution Factor (for Human Health Criteria)  
 Max Conc. at edge of Chronic Zone, µg/L (C<sub>e</sub>)  
 Reasonable Potential to exceed HH Water & Organism  
 Reasonable Potential to exceed HH Organism Only

**Human Health, Water + Organism, Effluent Limit Calculations**

Number of Compliance Samples Expected per month (n)  
 equals wastewater allocation  
 Average Monthly Effluent Limit, µg/L TSD Multiplier, Table 5-3, using 99<sup>th</sup> and 95<sup>th</sup> %  
 Maximum Daily Effluent Limit, µg/L  
 Average Monthly Limit (AML), lb/day  
 Maximum Daily Limit (MDL), lb/day

Enter the proposed number of monthly compliance samples if limit is necessary.  
 Reference TSD section 5.4.4 page 104.  
 The TSD suggests this could be used as the weekly average for municipals.

**Human Health, Organism Only, Effluent Limit Calculations**

Number of Compliance Samples Expected per month (n)  
 equals wastewater allocation  
 Average Monthly Effluent Limit, µg/L TSD Multiplier, Table 5-3, using 99<sup>th</sup> and 95<sup>th</sup> %  
 Maximum Daily Effluent Limit, µg/L  
 Average Monthly Limit (AML), lb/day  
 Maximum Daily Limit (MDL), lb/day

References:  
 Idaho Water Quality Standards <http://adminrules.idaho.gov/rules/current/58/0102.pdf>  
 Technical Support Document for Water Quality-based Toxics Control, US EPA, March 1991, EPA/505/2-90-001 <http://www.epa.gov/hqdespubs/owm/0264.pdf>  
 File name: [https://sepa-my.sharepoint.com/personal/jacobs\\_patrik\\_epa\\_gov/Documents/Desktop/Workspace/TSD\\_RP\\_W](https://sepa-my.sharepoint.com/personal/jacobs_patrik_epa_gov/Documents/Desktop/Workspace/TSD_RP_W) Version Date: 4/18/2016





DICHLOROBROMOMETHANE	27	75274	12V						Y	Y		0.55		17		
DICHLORODIFLUOROMETHANE		75718	13V													
DIEHTYL PHTHALATE	79	84662										17000		44000		
DIELDRIN	111	60571	10P					2.5	Y	Y	0.0019	0.000052		0.000054		
DIETHYLPHTHALATE	80	84662	24B						Y	N		270000		1100000		
DIMETHYLPHTHALATE		131113	25B						Y	N		313000				
DI-n-BUTYL PHTHALATE	81	84742	26B						Y	N		2000		4500		
DINITROTOLUENE 2,4	82	121142	27B						Y	Y		0.11		3.4		
DINITROTOLUENE 2,6	83	606202	28B						Y	N						
DI-N-OCTYL PHTHALATE	84	117840														
DIOXIN (2,3,7,8-TCDD)	16	1746016							Y	Y		5.00E-09		5.10E-09		
ENDOSULFAN alpha	112	959988	11P					0.22			0.056	62		89		
ENDOSULFAN beta	113	13213660	12P					0.22	Y	N	0.056	62		89		
ENDOSULFAN SULFATE	114	1031078	13P						Y	N		62		89		
ENDRIN	115	72208						0.18	Y	N	0.0023	0.059		0.060		
ENDRIN ALDEHYDE	116	7421934	15P						Y	N		0.29		0.30		
ETHYLBENZENE	33	100414	19V						Y	N		530		2100		
FLUORANTHENE	86	206440	31B						Y	N		130		140		
FLUORENE	87	86737	32B						Y	N		1100		5300		
GASSES, TOTAL DISSOLVED	x								N	N				see WAC 173-201A and the Gold Book		
HEPTACHLOR	117	76448	16P					0.52	Y	Y	0.0038	0.000079		0.000079		
HEPTACHLOR EPOXIDE	118	1024573	17P					0.52	Y	Y	0.0038	0.000039		0.000039		
HEXACHLOROBENZENE	88	118741	33B						Y	Y		0.00028		0.00029		
HEXACHLOROBUTADIENE	89	87683	34B						Y	Y		0.44		18		
HEXACHLOROCYCLOHEXANE-ALPHA	pesticide	319846	2P						Y	Y		0.0039				
HEXACHLOROCYCLOHEXANE-BETA	pesticide	319857	3P						Y	Y		0.014				
HEXACHLOROCYCLOHEXANE-GAMMA (lindane)	pesticide	58899	4P					2	Y	Y	0.08	0.019				
HEXACHLOROCYCLOPENTADIENE	90	77474	35B						Y	N		40		1100		
HEXACHLOROETHANE	91	67721	36B						N	Y		1.40		3.3		
INDENO(1,2,3-cd)PYRENE	92	193395	37B						Y	Y		0.0038		0.0180		
IRON	x	7439896							N	N		1000		300.00		
ISOPHORONE	93	78591	38B						Y	Y		35		960		
LEAD - SEE Toxic BiOp	7	7439921	7M	Hardness	100.0	100.0	1	1	Y	N	65	2.5	Narrative	Narrative	0.79	0.79
MANGANESE	x	7439965							N	N		50.00				
MERCURY - SEE Toxic BiOp	8	7439976	8M						Y	N	2.10	0.012				
METHYL BROMIDE	34	74839	20V						Y	N		47		1500		
METHYL CHLORIDE	35	74873	21V										narrative	narrative		
METHYLENE CHLORIDE	36	75092	22V						Y	Y		4.6		590.0		
METHYLMERCURY	8.1	72967926												0.3 mg/kg		
MONOCHLOROBENZENE		108907							Y	N				See Chlorobenzene		
N- NITROSODI-N-PROPYLAMINE	97	621647	42B						N	Y		0.0050		0.51		
NAPHTHALENE	94	91203	39B						Y	N						
NICKEL - SEE Toxic BiOp	9	7440020	9M	Hardness	100.0	100.0	1	1	Y	N	468	52	610	4600	1.00	1.00
NITRATE/NITRITE (N)	x								N	N			10000			
NITROBENZENE	95	98953	40B						Y	N		17		690		
NITROSAMINES									Y	Y		0.0008				
NITROSODIBUTYLAMINE N		924163							Y	Y		0.0063				
NITROSODIETHYLAMINE, N		55185							Y	Y		0.0008				
NITROSODIMETHYLAMINE N	96	62759	41B						Y	Y		0.00069		3.0		
NITROSODIPHENYLAMINE N	98	86306	43B						Y	Y		3.3		6.0		
NITROSOPYRROLIDINE, N		930552							Y	Y						
NONYLPHENOL								27.90			5.90					
OIL AND GREASE	x								N	N				See Gold Book and EPA 440/9-76-023		
OXYGEN DISSOLVED	x	7782447							N	N				See WAC 173-201A		
PARATHION		56382						0.065	N	N	0.013					
PENTACHLOROBENZENE		608935							N	N			1.40			
PENTACHLOROPHENOL	53	87865	9A	pH	7.80				Y	Y	20	13	0.27	3.0		
pH	x								N	N			6.5 - 8.5			
PHENANTHRENE	99	85018														
PHENOL	54	108952	10A						Y	N		21000		1,700,000		

Polychlorinated Biphenyls (PCB's)	119	2674112	18P-24P						Y	Y	0.014	0.000064	0.000064			
PYRENE	100	129000	45B						Y	N		830	4000			
SELENIUM (as total recoverable) - SEE Toxic BiOp	10	7782492	10M						Y	N	20	5	170	4200		
SILVER	11	7740224	11M	Hardness	100.0	100.0	1	1	Y	N	3.4				0.85	na
SOLIDS,DISSOLVED AND SALINITY	x								N	N		See Gold Book	250000			
SOLIDS,SUSPENDED AND TURBIDITY	x								N	N		See EPA 440/9-76-023 and WAC 173-201A				
SULFIDE, HYDROGEN SULFIDE	x	7783064							N	N		2.0				
TETRACHLOROETHANE 1,1,2,2	37	79345	23V						Y	Y			0.17	4.0		
TETRACHLOROETHYLENE	38	127184	24V						Y	Y			0.69	3.3		
TETRACHLOROPHENOL 2,3,4,6									Y	N						
THALLIUM	12	7440280	12M						Y	N			0.24	0.47		
TOLUENE	39	108883	25V						Y	N			1300	15000		
TOXAPHENE	120	8001352									0.73	0.0002	0.000280	0.000280		
TOXAPHENE		8001352	25P						Y	Y	0.73	0.0002	0.00073			
TRIBUTYLTIN (TBT)									N		0.460	0.063				
TRICHLOROBENZENE 1,2,4	101	120821	46B						N				35	70		
TRICHLOROETHANE 1,1,1	41	71556	27V						Y	N			narrative	narrative		
TRICHLOROETHANE 1,1,2	42	79005	28V						Y	Y			0.59	16		
TRICHLOROETHYLENE	43	79016	29V						Y	Y			2.50	30		
TRICHLOROPHENOL 2,4,5		95954							N	N						
TRICHLOROPHENOL 2,4,6	55	88062	11A						Y	Y			1.4	2.4		
VINYL CHLORIDE	44	75014	31V						Y	Y			0.025	2.4		
ZINC - SEE Toxic BiOp	13	7440666	13M	Hardness	100.0	100.0	1	1	Y	N	117	118	7400	26000	0.98	0.99

## Calculate Reasonable Potential Multiplier

(Ref. Page 57 TSD)

Input Field indication in Red

Number of Samples in Data Set (n)		<b>10</b>
Coefficient of Variation (CV) = Std. Dev./Mean		<b>0.6</b>
$\sigma$	$\sigma^2 = \ln(CV^2 + 1)$	0.555
$P_n$	$= (1 - \text{confidence level})^{1/n}$ where confidence level =	<b>99%</b> 0.631
RP Multiplier	$= \exp(z\sigma - 0.5\sigma^2) / \exp[\text{invnorm}(P_n)\sigma - 0.5\sigma^2]$ , prob.basis =	<b>99%</b> <b>3.0</b>

## Create Table of RP Multipliers

Values used by R10 states

ID	AK	OR	WA
99%	95%	99%	95%
99%	99%	95%	95%
3.0	2.5	2.1	1.7

Confidence Level = **99%**

Probability Basis = **99%**

For Example: CV=0.6, n=10, RP Multiplier

n = Number of Samples in Data Set

CV = Coefficient of Variation (CV) = Std. Dev./Mean (default CV = 0.6)

Coefficient of Variation (CV) = Std. Dev./Mean (default CV = 0.6)

n	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2
1	1.6	2.5	3.9	6.0	9.0	13.2	18.9	26.4	36.0	48.1	63.0	81.0	102.3	127.3	156.2	189.2	226.5	268.3	314.7	366.0
2	1.4	2.0	2.9	4.0	5.5	7.4	9.8	12.6	16.1	20.2	24.8	30.2	36.2	42.9	50.2	58.3	67.0	76.4	86.5	97.2
3	1.4	1.9	2.5	3.3	4.4	5.6	7.1	8.9	11.0	13.4	16.0	18.9	22.1	25.6	29.4	33.4	37.7	42.2	47.0	52.0
4	1.3	1.7	2.3	2.9	3.8	4.7	5.9	7.2	8.7	10.3	12.2	14.1	16.3	18.6	21.0	23.6	26.3	29.1	32.0	35.1
5	1.3	1.7	2.1	2.7	3.4	4.2	5.1	6.2	7.3	8.6	10.0	11.5	13.1	14.8	16.5	18.4	20.3	22.3	24.4	26.5
6	1.3	1.6	2.0	2.5	3.1	3.8	4.6	5.5	6.4	7.5	8.6	9.8	11.1	12.4	13.8	15.2	16.7	18.2	19.8	21.4
7	1.3	1.6	2.0	2.4	2.9	3.5	4.2	5.0	5.8	6.7	7.6	8.6	9.7	10.8	11.9	13.1	14.3	15.5	16.8	18.1
8	1.2	1.5	1.9	2.3	2.8	3.3	3.9	4.6	5.3	6.1	6.9	7.8	8.7	9.6	10.5	11.5	12.5	13.6	14.6	15.7
9	1.2	1.5	1.8	2.2	2.7	3.2	3.7	4.3	4.9	5.6	6.3	7.1	7.9	8.7	9.5	10.4	11.2	12.1	13.0	13.9
10	1.2	1.5	1.8	2.2	2.6	3.0	3.5	4.1	4.6	5.3	5.9	6.6	7.3	8.0	8.7	9.4	10.2	11.0	11.7	12.5
11	1.2	1.5	1.8	2.1	2.5	2.9	3.4	3.9	4.4	4.9	5.5	6.1	6.7	7.4	8.0	8.7	9.4	10.0	10.7	11.4
12	1.2	1.4	1.7	2.0	2.4	2.8	3.2	3.7	4.2	4.7	5.2	5.8	6.3	6.9	7.5	8.1	8.7	9.3	9.9	10.5
13	1.2	1.4	1.7	2.0	2.3	2.7	3.1	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.6	8.1	8.7	9.2	9.8
14	1.2	1.4	1.7	2.0	2.3	2.6	3.0	3.4	3.8	4.3	4.7	5.2	5.7	6.2	6.6	7.1	7.6	8.1	8.6	9.1
15	1.2	1.4	1.6	1.9	2.2	2.6	2.9	3.3	3.7	4.1	4.5	5.0	5.4	5.9	6.3	6.8	7.2	7.7	8.1	8.6
16	1.2	1.4	1.6	1.9	2.2	2.5	2.8	3.2	3.6	4.0	4.4	4.8	5.2	5.6	6.0	6.4	6.9	7.3	7.7	8.1
17	1.2	1.4	1.6	1.9	2.1	2.4	2.8	3.1	3.5	3.8	4.2	4.6	5.0	5.4	5.8	6.1	6.5	6.9	7.3	7.7
18	1.2	1.4	1.6	1.8	2.1	2.4	2.7	3.0	3.4	3.7	4.1	4.4	4.8	5.2	5.5	5.9	6.3	6.6	7.0	7.4
19	1.2	1.4	1.6	1.8	2.1	2.3	2.6	2.9	3.3	3.6	3.9	4.3	4.6	5.0	5.3	5.7	6.0	6.4	6.7	7.0
20	1.2	1.3	1.6	1.8	2.0	2.3	2.6	2.9	3.2	3.5	3.8	4.1	4.5	4.8	5.1	5.5	5.8	6.1	6.4	6.7

## Multiplier to Calculate Long Term Average (LTA) from Waste Load Allocation (WLA)

n = 4, or n=30 for ammonia		<b>4</b>
Coefficient of Variation (CV) = Std. Dev./Mean		<b>0.6</b>
$\sigma$ = std deviation	$\sigma^2 = \ln(CV^2 + 1)$	0.555
WLA, Acute Factor	$\exp(0.5\sigma^2 - z\sigma)$ ; where % probability basis =	<b>99%</b> <b>0.343</b>
WLA, Chronic Factor	$\exp(0.5\sigma_n^2 - z\sigma_n)$ ; where % probability basis =	<b>99%</b> <b>0.527</b>

Reference: TSD Page 102

Calculation:

WLA x Multiplier = LTA

LTA, Acute = WLA, acute x Multiplier

	x	0.343	=	0
	x	0.527	=	0

LTA, chronic = WLA, chronic x Multiplier

LTA, limiting = Min (LTA, acute; LTA, chronic) If TMDL, assume LTA = WLA **0**

## Multiplier to Calculate Permit Limits from LTA

Reference: TSD Page 103

Number of Samples per Month (n)		<b>4</b>
Coefficient of Variation (CV) = Std. Dev./Mean		<b>0.6</b>

$\sigma$ = std deviation	$\sigma^2 = \ln(CV^2 + 1)$		0.555
Average Monthly Limit (AML),	$\exp(z\sigma_n - 0.5z\sigma_n^2)$ ; where % probability basis =	95%	1.55
Maximum Daily Limit (MDL),	$\exp(z\sigma - 0.5z\sigma^2)$ ; where % probability basis =	99%	3.12

**Calculation:**

AML = LTA, limiting x Multiplier

MDL = LTA, limiting x Multiplier

**LTA, Limiting x Multiplier = Limit**

0	x	1.55	=	0
0	x	3.12	=	0

### Multiplier to Calculate Maximum Daily Limit from Average Monthly Limit

Number of Samples per Month Set (n)		4	
Coefficient of Variation (CV) = Std. Dev./Mean		0.6	
$\sigma$ = std deviation	$\sigma^2 = \ln(CV^2 + 1)$	0.555	
Average Monthly Limit (AML),	$\exp(z\sigma_n - 0.5z\sigma_n^2)$ ; where % probability basis =	95%	1.55
Maximum Daily Limit (MDL),	$\exp(z\sigma - 0.5z\sigma^2)$ ; where % probability basis =	99%	3.12
Ratio MDL/AML		2.01	

Reference: TSD Page 106

**Calculation:**

MDL = AML x Multiplier

**AML x Multiplier = MDL**

0	x	2.01	=	0
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### Multiplier to Calculate Average Weekly Limit (AWL) from Average Monthly Limit

Number of Samples per Month Set (n)		4	
Number of Samples per Week Set (n/4)		1	
Coefficient of Variation (CV) = Std. Dev./Mean		0.6	
$\sigma$ = std deviation	$\sigma^2 = \ln(CV^2 + 1)$	0.555	
Average Monthly Limit (AML),	$\exp(z\sigma_n - 0.5z\sigma_n^2)$ ; where % probability basis =	95%	1.55
Average Weekly Limit (AWL),	$\exp(z\sigma_{n/4} - 0.5z\sigma_{n/4}^2)$ ; where % probability basis =	99%	3.12
Ratio AWL/AML		2.01	

Adapted from TSD Page 106, where n = (default AWL/AML Multiplier = 1.5)

**Calculation:**

AWL = AML x Multiplier

**AML x Multiplier = AWL**

0	x	2.01	=	0
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Instructions: Enter data on Reasonable Potential tab and below with yellow fields and red text.

<p>Total ammonia nitrogen criteria (mg N/L):  <b>Annual Basis</b>                      Based on IDAPA 58.01.02</p>		<p><b>Acute Criteria Equation: Cold Water</b></p> $CMC = \frac{0.275}{1 + 10^{7.204 - pH}} + \frac{39.0}{1 + 10^{pH - 7.204}}$
<p><b>INPUT</b></p> <p>1. Receiving Water Temperature (deg C): 0.0                      2. Receiving Water pH: 0.00                      3. Is the receiving water a cold water designated use? Yes                      4. Are non-salmonid early life stages present or absent? Present</p>		<p><b>Acute Criteria Equation: Warm Water</b></p> $CMC = \frac{0.411}{1 + 10^{7.204 - pH}} + \frac{58.4}{1 + 10^{pH - 7.204}}$
<p><b>OUTPUT</b></p> <p>Total ammonia nitrogen criteria (mg N/L):  <b>Acute Criterion (CMC)</b> 39.00  <b>Chronic Criterion (CCC)</b> 7.09</p>		<p><b>Chronic Criteria: Cold water, Early Life Stages Present</b></p> $CCC = \left( \frac{0.0577}{1 + 10^{7.688 - pH}} + \frac{2.487}{1 + 10^{pH - 7.688}} \right) \cdot MIN(2.85, 1.45 \cdot 10^{0.028(25-T)})$
		<p><b>Chronic Criteria: Cold water, Early Life Stages Absent</b></p> $CCC = \left( \frac{0.0577}{1 + 10^{7.688 - pH}} + \frac{2.487}{1 + 10^{pH - 7.688}} \right) \cdot 1.45 \cdot 10^{0.028(25-T)}$
<p>Total ammonia nitrogen criteria (mg N/L):  <b>Seasonal Basis - LOW Flow</b>                      Based on IDAPA 58.01.02</p>		
<p><b>INPUT</b></p> <p>1. Receiving Water Temperature (deg C): 0.0                      2. Receiving Water pH: 0.00                      3. Is the receiving water a cold water designated use? Yes                      4. Are non-salmonid early life stages present or absent? Present</p>		<p><b>Acute Criteria Equation: Cold Water</b></p> $CMC = \frac{0.275}{1 + 10^{7.204 - pH}} + \frac{39.0}{1 + 10^{pH - 7.204}}$
		<p><b>Acute Criteria Equation: Warm Water</b></p> $CMC = \frac{0.411}{1 + 10^{7.204 - pH}} + \frac{58.4}{1 + 10^{pH - 7.204}}$
<p><b>OUTPUT</b></p> <p>Total ammonia nitrogen criteria (mg N/L):  <b>Acute Criterion (CMC)</b> 39.00  <b>Chronic Criterion (CCC)</b> 7.09</p>		<p><b>Chronic Criteria: Cold water, Early Life Stages Present</b></p> $CCC = \left( \frac{0.0577}{1 + 10^{7.688 - pH}} + \frac{2.487}{1 + 10^{pH - 7.688}} \right) \cdot MIN(2.85, 1.45 \cdot 10^{0.028(25-T)})$
		<p><b>Chronic Criteria: Cold water, Early Life Stages Absent</b></p> $CCC = \left( \frac{0.0577}{1 + 10^{7.688 - pH}} + \frac{2.487}{1 + 10^{pH - 7.688}} \right) \cdot 1.45 \cdot 10^{0.028(25-T)}$
<p>Total ammonia nitrogen criteria (mg N/L):  <b>Seasonal Basis - HIGH Flow</b>                      Based on IDAPA 58.01.02</p>		
<p><b>INPUT</b></p> <p>1. Receiving Water Temperature (deg C): 0.0                      2. Receiving Water pH: 0.00                      3. Is the receiving water a cold water designated use? Yes                      4. Are non-salmonid early life stages present or absent? Present</p>		<p><b>Acute Criteria Equation: Cold Water</b></p> $CMC = \frac{0.275}{1 + 10^{7.204 - pH}} + \frac{39.0}{1 + 10^{pH - 7.204}}$
		<p><b>Acute Criteria Equation: Warm Water</b></p> $CMC = \frac{0.411}{1 + 10^{7.204 - pH}} + \frac{58.4}{1 + 10^{pH - 7.204}}$
<p><b>OUTPUT</b></p> <p>Total ammonia nitrogen criteria (mg N/L):  <b>Acute Criterion (CMC)</b> 39.00  <b>Chronic Criterion (CCC)</b> 7.09</p>		<p><b>Chronic Criteria: Cold water, Early Life Stages Present</b></p> $CCC = \left( \frac{0.0577}{1 + 10^{7.688 - pH}} + \frac{2.487}{1 + 10^{pH - 7.688}} \right) \cdot MIN(2.85, 1.45 \cdot 10^{0.028(25-T)})$
		<p><b>Chronic Criteria: Cold water, Early Life Stages Absent</b></p> $CCC = \left( \frac{0.0577}{1 + 10^{7.688 - pH}} + \frac{2.487}{1 + 10^{pH - 7.688}} \right) \cdot 1.45 \cdot 10^{0.028(25-T)}$

**Aquatic Life Ambient Water Quality Criteria for Ammonia - Freshwater 2013**

EPA 822-R-13-001 April 2013

<http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/ammonia/upload/AQUATIC-LIFE-AMBIENT-WATER-QUALITY-CRITERIA-FOR-AMMONIA-FRESHWATER-2013.pdf>

Acute 1-hour average

**CMC Acute Criterion Magnitude**

Oncorhynchus species are Present

T	15.3 °C
pH	7 S.U
CMC=	24 mg TAN/L

$$CMC = MIN \left( \left( \frac{0.275}{1 + 10^{7.204 - pH}} + \frac{39.0}{1 + 10^{pH - 7.204}} \right), \left( 0.7249 \times \left( \frac{0.0114}{1 + 10^{7.204 - pH}} + \frac{1.6181}{1 + 10^{pH - 7.204}} \right) \times (23.12 \times 10^{0.036 \times (20 - T)}) \right) \right)$$

Reproduction of table on page 44

pH/Temp	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
6.5	32.61	32.61	31.59	29.08	26.76	24.63	22.67	20.87	19.21	17.68	16.28	14.98	13.79	12.69	11.68	10.75	9.90
6.6	31.28	31.28	30.30	27.89	25.67	23.63	21.75	20.02	18.43	16.96	15.61	14.37	13.23	12.18	11.21	10.32	9.50
6.7	29.76	29.76	28.83	26.54	24.43	22.48	20.69	19.05	17.53	16.14	14.85	13.67	12.59	11.58	10.66	9.81	9.03
6.8	28.05	28.05	27.17	25.01	23.02	21.19	19.50	17.95	16.52	15.21	14.00	12.88	11.86	10.92	10.05	9.25	8.51
6.9	26.15	26.15	25.33	23.32	21.46	19.76	18.18	16.74	15.41	14.18	13.05	12.01	11.06	10.18	9.37	8.62	7.94
7	24.10	24.10	23.35	21.49	19.78	18.21	17	15.43	14.20	13.07	12.03	11.07	10.19	9.38	8.64	7.95	7.32
7.1	21.94	21.94	21.26	19.57	18.01	16.58	15.26	14.05	12.93	11.90	10.95	10.08	9.28	8.54	7.86	7.24	6.66
7.2	19.73	19.73	19.11	17.59	16.19	14.90	13.72	12.63	11.62	10.70	9.85	9.06	8.34	7.68	7.07	6.51	5.99
7.3	17.51	17.51	16.96	15.61	14.37	13.22	12.17	11.20	10.31	9.49	8.74	8.04	7.40	6.81	6.27	5.77	5.31
7.4	15.34	15.34	14.86	13.68	12.59	11.59	10.67	9.82	9.04	8.32	7.66	7.05	6.49	5.97	5.50	5.06	4.66
7.5	13.28	13.28	12.87	11.84	10.90	10.03	9.24	8.50	7.83	7.20	6.63	6.10	5.62	5.17	4.76	4.38	4.03
7.6	11.37	11.37	11.02	10.14	9.34	8.59	7.91	7.28	6.70	6.17	5.68	5.23	4.81	4.43	4.08	3.75	3.45
7.7	9.64	9.64	9.34	8.60	7.92	7.29	6.71	6.17	5.68	5.23	4.81	4.43	4.08	3.75	3.46	3.18	2.93
7.8	8.11	8.11	7.85	7.23	6.65	6.12	5.64	5.19	4.78	4.40	4.05	3.72	3.43	3.16	2.90	2.67	2.46
7.9	6.77	6.77	6.55	6.03	5.55	5.11	4.70	4.33	3.99	3.67	3.38	3.11	2.86	2.63	2.42	2.23	2.05
8	5.62	5.62	5.44	5.01	4.61	4.24	3.90	3.59	3.31	3.04	2.80	2.58	2.37	2.19	2.01	1.85	1.70
8.1	4.64	4.64	4.50	4.14	3.81	3.51	3.23	2.97	2.73	2.52	2.32	2.13	1.96	1.81	1.66	1.53	1.41
8.2	3.83	3.83	3.71	3.41	3.14	2.89	2.66	2.45	2.25	2.07	1.91	1.76	1.62	1.49	1.37	1.26	1.16
8.3	3.15	3.15	3.05	2.81	2.58	2.38	2.19	2.02	1.86	1.71	1.57	1.45	1.33	1.23	1.13	1.04	0.96
8.4	2.59	2.59	2.51	2.31	2.13	1.96	1.80	1.66	1.53	1.41	1.29	1.19	1.10	1.01	0.93	0.86	0.79
8.5	2.14	2.14	2.07	1.91	1.76	1.62	1.49	1.37	1.26	1.16	1.07	0.98	0.90	0.83	0.77	0.71	0.65
8.6	1.77	1.77	1.72	1.58	1.45	1.34	1.23	1.13	1.04	0.96	0.88	0.81	0.75	0.69	0.63	0.58	0.54
8.7	1.47	1.47	1.43	1.31	1.21	1.11	1.02	0.94	0.87	0.80	0.73	0.68	0.62	0.57	0.53	0.49	0.45
8.8	1.23	1.23	1.19	1.10	1.01	0.93	0.86	0.79	0.73	0.67	0.62	0.57	0.52	0.48	0.44	0.41	0.37
8.9	1.04	1.04	1.01	0.93	0.85	0.79	0.72	0.67	0.61	0.56	0.52	0.48	0.44	0.40	0.37	0.34	0.32
9	0.88	0.88	0.86	0.79	0.73	0.67	0.62	0.57	0.52	0.48	0.44	0.41	0.37	0.34	0.32	0.29	0.27

**CMC Acute Criterion Magnitude**

Oncorhynchus species are Absent

T	15.3 °C
pH	7 S.U
CMC=	25 mg TAN/L

$$CMC = 0.7249 \times \frac{0.0114}{1 + 10^{7.204 - pH}} + \frac{1.6181}{1 + 10^{pH - 7.204}} \times MIN(51.93, 23.12 \times 10^{0.036 \times (20 - T)})$$

Reproduction of table on page 45

pH/Temp	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
6.5	51	48	44	41	37	34	31.59	29.08	26.76	24.63	22.67	20.87	19.21	17.68	16.28	14.98	13.79	12.69	11.68	10.75	9.90
6.6	49	46	42	39	36	33	30.30	27.89	25.67	23.63	21.75	20.02	18.43	16.96	15.61	14.37	13.23	12.18	11.21	10.32	9.50
6.7	46	44	40	37	34	31	28.83	26.54	24.43	22.48	20.69	19.05	17.53	16.14	14.85	13.67	12.59	11.58	10.66	9.81	9.03
6.8	44	41	38	35	32	30	27.17	25.01	23.02	21.19	19.50	17.95	16.52	15.21	14.00	12.88	11.86	10.92	10.05	9.25	8.51
6.9	41	38	35	32	30	28	25.33	23.32	21.46	19.76	18.18	16.74	15.41	14.18	13.05	12.01	11.06	10.18	9.37	8.62	7.94
7	38	35	33	30	28	25	23.35	21.49	19.78	18.21	17	15.43	14.20	13.07	12.03	11.07	10.19	9.38	8.64	7.95	7.32
7.1	34	32	30	27	25	23	21.26	19.57	18.01	16.58	15.26	14.05	12.93	11.90	10.95	10.08	9.28	8.54	7.86	7.24	6.66
7.2	31	29	27	25	23	21	19.11	17.59	16.19	14.90	13.72	12.63	11.62	10.70	9.85	9.06	8.34	7.68	7.07	6.51	5.99
7.3	27	26	24	22	20	18	16.96	15.61	14.37	13.22	12.17	11.20	10.31	9.49	8.74	8.04	7.40	6.81	6.27	5.77	5.31
7.4	24	22	21	19	18	16	14.86	13.68	12.59	11.59	10.67	9.82	9.04	8.32	7.66	7.05	6.49	5.97	5.50	5.06	4.66
7.5	21	19	18	17	15	14	12.87	11.84	10.90	10.03	9.24	8.50	7.83	7.20	6.63	6.10	5.62	5.17	4.76	4.38	4.03

7.6	18	17	15	14	13	12	11.02	10.14	9.34	8.59	7.91	7.28	6.70	6.17	5.68	5.23	4.81	4.43	4.08	3.75	3.45
7.7	15	14	13	12	11	10	9.34	8.60	7.92	7.29	6.71	6.17	5.68	5.23	4.81	4.43	4.08	3.75	3.46	3.18	2.93
7.8	13	12	11	10	9	9	7.85	7.23	6.65	6.12	5.64	5.19	4.78	4.40	4.05	3.72	3.43	3.16	2.90	2.67	2.46
7.9	11	10	9	8	8	7	6.55	6.03	5.55	5.11	4.70	4.33	3.99	3.67	3.38	3.11	2.86	2.63	2.42	2.23	2.05
8	8.77	8.23	7.58	6.98	6.42	5.91	5.44	5.01	4.61	4.24	3.90	3.59	3.31	3.04	2.80	2.58	2.37	2.19	2.01	1.85	1.70
8.1	7.25	6.80	6.26	5.76	5.31	4.88	4.50	4.14	3.81	3.51	3.23	2.97	2.73	2.52	2.32	2.13	1.96	1.81	1.66	1.53	1.41
8.2	5.97	5.61	5.16	4.75	4.37	4.03	3.71	3.41	3.14	2.89	2.66	2.45	2.25	2.07	1.91	1.76	1.62	1.49	1.37	1.26	1.16
8.3	4.92	4.62	4.25	3.91	3.60	3.31	3.05	2.81	2.58	2.38	2.19	2.02	1.86	1.71	1.57	1.45	1.33	1.23	1.13	1.04	0.96
8.4	4.05	3.80	3.50	3.22	2.97	2.73	2.51	2.31	2.13	1.96	1.80	1.66	1.53	1.41	1.29	1.19	1.10	1.01	0.93	0.86	0.79
8.5	3.34	3.14	2.89	2.66	2.45	2.25	2.07	1.91	1.76	1.62	1.49	1.37	1.26	1.16	1.07	0.98	0.90	0.83	0.77	0.71	0.65
8.6	2.77	2.60	2.39	2.20	2.02	1.86	1.72	1.58	1.45	1.34	1.23	1.13	1.04	0.96	0.88	0.81	0.75	0.69	0.63	0.58	0.54
8.7	2.30	2.16	1.99	1.83	1.68	1.55	1.43	1.31	1.21	1.11	1.02	0.94	0.87	0.80	0.73	0.68	0.62	0.57	0.53	0.49	0.45
8.8	1.92	1.81	1.66	1.53	1.41	1.30	1.19	1.10	1.01	0.93	0.86	0.79	0.73	0.67	0.62	0.57	0.52	0.48	0.44	0.41	0.37
8.9	1.62	1.52	1.40	1.29	1.19	1.09	1.01	0.93	0.85	0.79	0.72	0.67	0.61	0.56	0.52	0.48	0.44	0.40	0.37	0.34	0.32
9	1.38	1.30	1.19	1.10	1.01	0.93	0.86	0.79	0.73	0.67	0.62	0.57	0.52	0.48	0.44	0.41	0.37	0.34	0.32	0.29	0.27

**Aquatic Life Ambient Water Quality Criteria for Ammonia - Freshwater 2013** EPA 822-R-13-001 April 2013

<http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/ammonia/upload/AQUATIC-LIFE-AMBIENT-WATER-QUALITY-CRITERIA-FOR-AMMONIA-FRESHWATER-2013.pdf>

Chronic 30-day rolling average, not to exceed 2.5 times the CCC as a 4-day average within the 30-days (i.e. 4.8 mg TAN/L once in 3 years on average) pg. 40

**CMC Chronic Criterion Magnitude**

T	15.3 °C
pH	7 S.U
CMC=	2.6 mg TAN/L

$$CCC = 0.8876 \times \left( \frac{0.0278}{1 + 10^{7.688 - pH}} + \frac{1.1994}{1 + 10^{pH - 7.688}} \right) \times (2.126 \times 10^{0.028 \times (20 - MAX(T, 7))})$$

**Reproduction of table on page 49**

pH/Temp	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
6.5	4.92	4.61	4.33	4.06	3.80	3.56	3.34	3.13	2.94	2.75	2.58	2.42	2.27	2.13	2.00	1.87	1.75	1.64	1.54	1.45	1.36	1.27	1.19	1.12
6.6	4.85	4.54	4.26	3.99	3.74	3.51	3.29	3.09	2.89	2.71	2.54	2.38	2.24	2.10	1.96	1.84	1.73	1.62	1.52	1.42	1.33	1.25	1.17	1.10
6.7	4.75	4.46	4.18	3.92	3.67	3.44	3.23	3.03	2.84	2.66	2.50	2.34	2.19	2.06	1.93	1.81	1.69	1.59	1.49	1.40	1.31	1.23	1.15	1.08
6.8	4.65	4.36	4.08	3.83	3.59	3.37	3.15	2.96	2.77	2.60	2.44	2.29	2.14	2.01	1.88	1.77	1.66	1.55	1.46	1.36	1.28	1.20	1.12	1.05
6.9	4.51	4.23	3.97	3.72	3.49	3.27	3.07	2.87	2.70	2.53	2.37	2.22	2.08	1.95	1.83	1.72	1.61	1.51	1.41	1.33	1.24	1.17	1.09	1.02
7	4.36	4.09	3.83	3.59	3.37	3.16	2.96	2.78	2.60	2.44	2.29	2.15	2.01	1.89	1.77	1.66	1.55	1.46	1.37	1.28	1.20	1.13	1.06	0.99
7.1	4.18	3.92	3.67	3.45	3.23	3.03	2.84	2.66	2.50	2.34	2.19	2.06	1.93	1.81	1.70	1.59	1.49	1.40	1.31	1.23	1.15	1.08	1.01	0.95
7.2	3.97	3.73	3.49	3.28	3.07	2.88	2.70	2.53	2.37	2.22	2.09	1.96	1.83	1.72	1.61	1.51	1.42	1.33	1.25	1.17	1.09	1.03	0.96	0.90
7.3	3.74	3.51	3.29	3.09	2.89	2.71	2.54	2.38	2.24	2.10	1.96	1.84	1.73	1.62	1.52	1.42	1.33	1.25	1.17	1.10	1.03	0.97	0.91	0.85
7.4	3.49	3.27	3.07	2.88	2.70	2.53	2.37	2.22	2.08	1.95	1.83	1.72	1.61	1.51	1.42	1.33	1.24	1.17	1.09	1.03	0.96	0.90	0.84	0.79
7.5	3.22	3.02	2.83	2.65	2.49	2.33	2.18	2.05	1.92	1.80	1.69	1.58	1.48	1.39	1.30	1.22	1.15	1.07	1.01	0.94	0.89	0.83	0.78	0.73
7.6	2.93	2.75	2.58	2.41	2.26	2.12	1.99	1.87	1.75	1.64	1.54	1.44	1.35	1.27	1.19	1.11	1.04	0.98	0.92	0.86	0.81	0.76	0.71	0.66
7.7	2.64	2.47	2.32	2.17	2.04	1.91	1.79	1.68	1.57	1.48	1.38	1.30	1.22	1.14	1.07	1.00	0.94	0.88	0.83	0.77	0.73	0.68	0.64	0.60
7.8	2.34	2.20	2.06	1.93	1.81	1.70	1.59	1.49	1.40	1.31	1.23	1.15	1.08	1.01	0.95	0.89	0.84	0.78	0.73	0.69	0.65	0.61	0.57	0.53
7.9	2.06	1.93	1.81	1.70	1.59	1.49	1.40	1.31	1.23	1.15	1.08	1.01	0.95	0.89	0.84	0.78	0.73	0.69	0.65	0.61	0.57	0.53	0.50	0.47
8	1.79	1.68	1.57	1.48	1.38	1.30	1.22	1.14	1.07	1.00	0.94	0.88	0.83	0.77	0.73	0.68	0.64	0.60	0.56	0.53	0.49	0.46	0.43	0.41
8.1	1.54	1.45	1.36	1.27	1.19	1.12	1.05	0.98	0.92	0.86	0.81	0.76	0.71	0.67	0.63	0.59	0.55	0.52	0.48	0.45	0.43	0.40	0.37	0.35
8.2	1.32	1.24	1.16	1.09	1.02	0.96	0.90	0.84	0.79	0.74	0.69	0.65	0.61	0.57	0.54	0.50	0.47	0.44	0.41	0.39	0.36	0.34	0.32	0.30
8.3	1.12	1.05	0.99	0.92	0.87	0.81	0.76	0.71	0.67	0.63	0.59	0.55	0.52	0.48	0.45	0.43	0.40	0.37	0.35	0.33	0.31	0.29	0.27	0.25
8.4	0.95	0.89	0.83	0.78	0.73	0.69	0.64	0.60	0.57	0.53	0.50	0.47	0.44	0.41	0.38	0.36	0.34	0.32	0.30	0.28	0.26	0.25	0.23	0.22
8.5	0.80	0.75	0.70	0.66	0.62	0.58	0.54	0.51	0.48	0.45	0.42	0.39	0.37	0.35	0.32	0.30	0.29	0.27	0.25	0.24	0.22	0.21	0.19	0.18
8.6	0.68	0.63	0.59	0.56	0.52	0.49	0.46	0.43	0.40	0.38	0.36	0.33	0.31	0.29	0.27	0.26	0.24	0.23	0.21	0.20	0.19	0.17	0.16	0.15
8.7	0.57	0.54	0.50	0.47	0.44	0.41	0.39	0.36	0.34	0.32	0.30	0.28	0.26	0.25	0.23	0.22	0.20	0.19	0.18	0.17	0.16	0.15	0.14	0.13
8.8	0.49	0.46	0.43	0.40	0.38	0.35	0.33	0.31	0.29	0.27	0.26	0.24	0.22	0.21	0.20	0.18	0.17	0.16	0.15	0.14	0.13	0.13	0.12	0.11
8.9	0.42	0.39	0.37	0.34	0.32	0.30	0.28	0.26	0.25	0.23	0.22	0.20	0.19	0.18	0.17	0.16	0.15	0.14	0.13	0.12	0.11	0.11	0.10	0.09
9	0.36	0.34	0.31	0.29	0.28	0.26	0.24	0.23	0.21	0.20	0.19	0.18	0.17	0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.10	0.09	0.09	0.08

Instructions: Enter data on Reasonable Potential tab and below with yellow fields and red text.

### Calculation of pH of a Mixture of Two Flows

Based on the procedure in EPA's DESCONE program (EPA, 1988. Technical Guidance on Supplementary Stream Design Conditions for Steady State Modeling. USEPA Office of Water, Washington D.C.)

INPUT	Yr. Around Basis		Comments
	Min Limit	Max Limit	
1. Dilution Factor at Mixing Zone Boundary	0.0	0.0	Chronic Dilution Factor at Design Flow and Low River Flow Conditions
2. Ambient/Upstream/Background Conditions			
Temperature (deg C):		0.00	Max. and min. temperature for lower and upper pH, respectively, based on USGS data
pH:	0.00		Min. and max. pH for lower and upper pH, respectively, based on USGS data.
Alkalinity (mg CaCO <sub>3</sub> /L):	25.00	25.00	USGS Data or estimate. 25 mg/L conservative estimate.
3. Effluent Characteristics			
Temperature (deg C):	22.00	5.00	Max and min for lower and upper temperature, DMR data
pH:	6.00	9.00	Lower and Upper Effluent Limits, Sec. Treatment Standards 6.0 to 9.0 or established based on WQS.
Alkalinity (mg CaCO <sub>3</sub> /L):	25.00	25.00	Refer to effluent data or WET data sheets.
4. Applicable Water Quality Standards	6.50	9.00	
<b>OUTPUT</b>			
1. Ionization Constants			
Upstream/Background pKa:	6.57	6.57	
Effluent pKa:	6.37	6.51	
2. Ionization Fractions			
Upstream/Background Ionization Fraction:	0.00	0.00	
Effluent Ionization Fraction:	0.30	1.00	
3. Total Inorganic Carbon			
Upstream/Background Total Inorganic Carbon (mg CaCO <sub>3</sub> /L):	92883832	92883832	
Effluent Total Inorganic Carbon (mg CaCO <sub>3</sub> /L):	83	25	
4. Conditions at Mixing Zone Boundary			
Temperature (deg C):	#DIV/0!	#DIV/0!	
Alkalinity (mg CaCO <sub>3</sub> /L):	#DIV/0!	#DIV/0!	
Total Inorganic Carbon (mg CaCO <sub>3</sub> /L):	#DIV/0!	#DIV/0!	
pKa:	#DIV/0!	#DIV/0!	
<b>RESULTS</b>			
pH at Mixing Zone Boundary:	#DIV/0!	#DIV/0!	
Reasonable Potential to contribute to excursion above WQS	#DIV/0!	#DIV/0!	

Instructions: Enter data below with yellow fields and red text. Use limits highlighted in blue and bold.

### Evaluation of Mass Effluent Limits

Max Month Design Criteria: **85% of Design**

Flow, MGD	0	0.0
BOD, lb/day		0
TSS, lb/day		0

	Effluent Limits, Concentration and Mass	
	Limit	Weekly Limit
<b>BOD<sub>5</sub>, mg/L</b>	30	45
<b>BOD<sub>5</sub>, lb/day</b>	0	0
<b>TSS, mg/L</b>	30	45
<b>TSS, lb/day</b>	0	0

Note: calculated values are truncated to ensure that permit limit is less than regulatory allowed and not greater than.

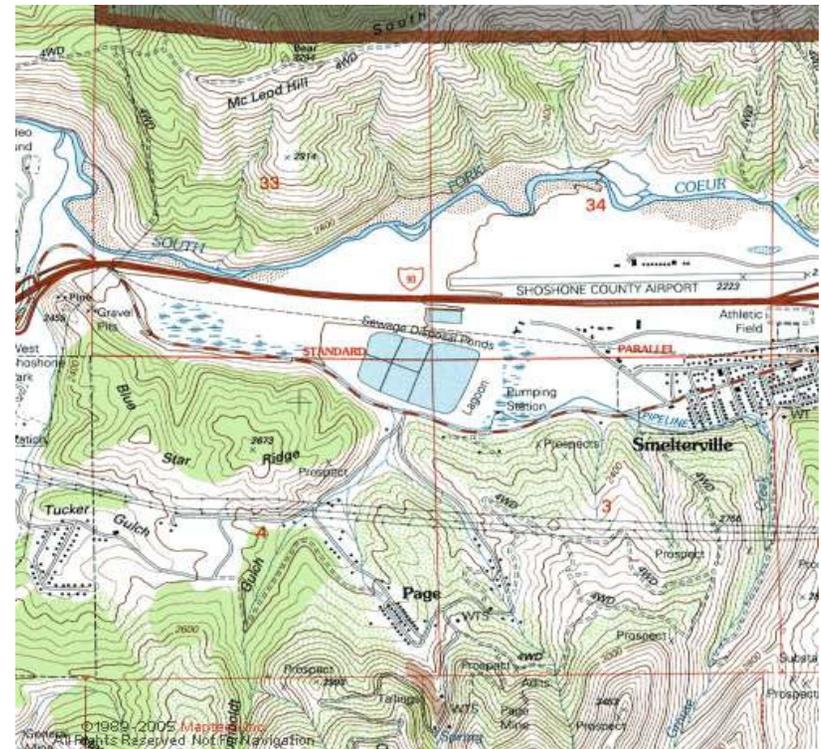
Plant Data		Units	Design Flow			INSTRUCTIONS				
Design Flow		mgd	0			<b>Enter Design Flow on RP and Limits Worksheet</b>				
Design Flow		cfs - calculated	--			Calculated using conversion factor 1.548				
Design BOD <sub>5</sub> , if available		lb/day				Optional				
Design TSS, if available		lb/day				Optional				
<b>Critical Receiving Water Flows - Annual Basis</b>						Annual critical flows means critical flows are calculate using all data on annual basis.				
Critical Flow Parameter		River Flow (cfs)	Used for evaluating criteria for:							
1Q10			Aquatic Life Uses - Acute			Enter Appropriate Critical Flows calculated using dFLOW				
7Q10			Aquatic Life Uses - Chronic			Enter Appropriate Critical Flows calculated using dFLOW				
30B3			Ammonia			Enter Appropriate Critical Flows calculated using dFLOW				
30Q5			Human Health – Non-carcinogen			Enter Appropriate Critical Flows calculated using dFLOW				
Harmonic Mean			Human Health – Carcinogen			Enter Appropriate Critical Flows calculated using dFLOW				
<b>Calculation of Dilution Factors based on Critical River Flows and design WWTP Flow</b>										
Dilution Factors	Allowable % of river flow	Dilution Factor	Basis	Receiving Water Concentration						
DF-edge of Acute zone	25%	--	1Q10							
DF-edge of Chronic zone	25%	--	7Q10							
Ammonia	25%	--	30B3							
HH-Non-Carcinogen	25%	--	30Q5							
HH-Carcinogen	25%	--	Harmonic Mean							
<b>Critical Receiving Water Flows - Seasonal Basis (Low Flow Period as specified)</b>						Low critical flows means the critical flows calculated on a seasonal basis during low river flow period.				
Critical Flow Parameter		River Flow (cfs)	Used for evaluating criteria for:							
1Q10			Aquatic Life Uses - Acute			OPTIONAL, only needed if seasonal limits will apply.				
7Q10			Aquatic Life Uses - Chronic			Enter Appropriate Critical Flows calculated using dFLOW				
30Q10			Ammonia			Enter Appropriate Critical Flows calculated using dFLOW				
30Q5			Human Health – Non-carcinogen			Enter Appropriate Critical Flows calculated using dFLOW				
Harmonic Mean			Human Health – Carcinogen			Enter Appropriate Critical Flows calculated using dFLOW				
<b>Calculation of Dilution Factors based on Critical River Flows and design WWTP Flow</b>										
Dilution Factors	Allowable % of river flow	Dilution Factor	Basis	Receiving Water Concentration						
DF-edge of Acute zone	25%	--	1Q10							
DF-edge of Chronic zone	25%	--	7Q10							
Ammonia	25%	--	30Q10							
HH-Non-Carcinogen	25%	--	30Q5							
HH-Carcinogen	25%	--	Harmonic Mean							
<b>Critical Receiving Water Flows - Seasonal Basis (High Flow Period as specified)</b>						High critical flows means the critical flows calculated on a seasonal basis during high river flow period.				
Critical Flow Parameter		River Flow (cfs)	Used for evaluating criteria for:							
1Q10			Aquatic Life Uses - Acute			OPTIONAL, only needed if seasonal limits will apply.				
						Enter Appropriate Critical Flows calculated using dFLOW				



Instructions: Enter data with yellow fields and red text.

### Streeter-Phelps Analysis of Critical Dissolved Oxygen Sag

INPUT			
<b>1. EFFLUENT CHARACTERISTICS</b>			
Discharge (cfs):			0
CBOD5 (mg/L):			25
NBOD (mg/L):			2.6
Dissolved Oxygen (mg/L):			2
Temperature (deg C):			20.7
<b>2. RECEIVING WATER CHARACTERISTICS</b>			
Upstream Discharge (cfs):			0
Upstream CBOD5 (mg/L):			1.5
Upstream NBOD (mg/L):			0.2
Upstream Dissolved Oxygen (mg/L):		5th Percentile at Smelterville	8.32
Upstream Temperature (deg C):		95th Percentile at Smelterville	20.7
Elevation (ft NGVD):		Topo Map	2200
Downstream Average Channel Slope (ft/ft):			0.00088
Downstream Average Channel Depth (ft):			4
Downstream Average Channel Velocity (fps):			1
<b>3. REAERATION RATE (Base e) at 20 deg C (day<sup>-1</sup>):</b>			
			3.57
<u>Reference</u>	<u>Applic. Vel (fps)</u>	<u>Applic. Dep (ft)</u>	<u>Suggested Values</u>
Churchill	1.5 - 6	2 - 50	1.14
O'Connor and Dobbins	0.1 - 1.5	2 - 50	1.62
Owens	0.1 - 6	1 - 2	1.66
Tsivoglou-Wallace	0.1 - 6	0.1 - 2	6.08
<b>4. BOD DECAY RATE (Base e) AT 20 deg C (day<sup>-1</sup>):</b>			
			2.51
(Suggested value = 2.51, Wright and McDonnell, 1979)			
OUTPUT			
<b>1. INITIAL MIXED RIVER CONDITION</b>			
CBOD5 (mg/L):			#DIV/0!
NBOD (mg/L):			#DIV/0!
Dissolved Oxygen (mg/L):			#DIV/0!
Temperature (deg C):			#DIV/0!
<b>2. TEMPERATURE ADJUSTED RATE CONSTANTS (Base e)</b>			
Reaeration (day <sup>-1</sup> ):			#DIV/0!
BOD Decay (day <sup>-1</sup> ):			#DIV/0!
<b>3. CALCULATED INITIAL ULTIMATE CBODU AND TOTAL BODU</b>			
Initial Mixed CBODU (mg/L):			#DIV/0!
Initial Mixed Total BODU (CBODU + NBOD, mg/L):			#DIV/0!
<b>4. INITIAL DISSOLVED OXYGEN DEFICIT</b>			
Saturation Dissolved Oxygen (mg/L):			#DIV/0!
Initial Deficit (mg/L):			#DIV/0!



5. TRAVEL TIME TO CRITICAL DO CONCENTRATION (days):	#DIV/0!
6. DISTANCE TO CRITICAL DO CONCENTRATION (miles):	#DIV/0!
7. CRITICAL DO DEFICIT (mg/L):	#DIV/0!
<b>8. CRITICAL DO CONCENTRATION (mg/L):</b>	<b>#DIV/0!</b>

Instructions: Enter data on Reasonable Potential tab and below with yellow fields and red text.

**Calculation of E. Coli at Chronic Mixing Zone**

INPUT		Data Source
Chronic Dilution Factor	0.0	Maximum monthly geomean during previous permit cycle 600 on 6-30-2007
Ambient E. Coli, #/100 ml		
Effluent E. Coli- worst case, #/100 ml	126	
Surface Water Criteria, #/100 ml	126	
OUTPUT		
<b>E. Coli at Mixing Zone Boundary, #/100 ml</b>	<b>126</b>	
Difference between mixed and ambient, #/100 ml	126	

**Conclusion: At design flow, the discharge has no reasonable potential to violate water quality standards for E. Coli.**

ID 58.01.02 251.01

- a 126 Geometric Mean of 5 samples taken of over 3-7 days over a 30 day period.
- b.i 576 Single sample max for secondary contact recreation.
- b.ii 406 Single sample max for primary contact recreation.
- b.iii 235 Single sample max for primary contact and public swimming beachers recreation.

**Calculation of Dissolved Oxygen at Chronic Mixing Zone**

INPUT		Data Source
Chronic Dilution Factor	0.0	5th percentile DMR data minimum.
Ambient DO Concentration, mg/L		
Effluent DO Concentration, mg/L		
Effluent Immediate DO Demand, mg/L		
Surface Water Criteria, mg/L		
OUTPUT		
<b>DO at Mixing Zone Boundary, mg/L</b>	<b>#DIV/0!</b>	

DO decrease caused by effluent at chronic boundary, mg/L	#DIV/0!
--	---------

#DIV/0!
---------

References: EPA/600/6-85/002b and EPA/430/9-82-011

ID 58.01.02 250

- |                         |   |
|-------------------------|---|
| 02.a Cold Water         | 6 mg/L at all times. Exceptions for lakes and reservoirs. |
| 02.f. Salmonid Spawning | 1-day min. 5.0 mg/L intergravel DO, 6.0 7-day average     |
| 03.a. Seasonal Cold     | 6 mg/L at all times. Exceptions for lakes and reservoirs. |
| 04.a. Warm Water        | 5 mg/L at all times. Exceptions for lakes and reservoirs. |

Instructions: Enter data on Reasonable Potential tab and below with yellow fields. Remove column if not needed.

### Freshwater Temperature Reasonable Potential and Limit Calculation

ID 58.01.02 250

02.b Cold Water	22.0 °C	<i>or less with maximum daily average temperature of</i>	19.0 °C	
02.f Salmonid Spawning	13.0 °C	<i>or less with maximum daily average temperature of</i>	9.0 °C	As determined by IDEQ "Water Body Assessment Guidance"
03.a Seasonal Cold	26.0 °C	<i>or less with maximum daily average temperature of</i>	23.0 °C	
04.a Warm Water	33.0 °C	<i>or less with maximum daily average temperature of</i>	29.0 °C	

		Cold Water Criteria	
INPUT			Data Source
Chronic Dilution Factor at Mixing Zone Boundary		0.0	High River Flow
Ambient Temperature (T) (Upstream Background)			95th Percentile based on permittee or USGS data
Effluent Temperature		22.0 °C	95th Percentile of <b>monthly daily max effluent</b> based on daily max per DMR data
Aquatic Life Temperature WQ Criterion in Fresh Water		19.0 °C	Lowest daily max criteria
OUTPUT			
Temperature at Chronic Mixing Zone Boundary:		#DIV/0!	Mass balance
Incremental Temperature Increase or decrease:		#DIV/0!	WQS 401.c - allow for maximum of 0.3°C rise in receiving water temperature.

Comments:

IDEQ "Water Body Assessment Guidance"

[http://www.deq.idaho.gov/media/457010-wbag\\_02\\_entire.pdf](http://www.deq.idaho.gov/media/457010-wbag_02_entire.pdf)

## Performance-based Effluent Limits

INPUT		
LogNormal Transformed Mean:		
LogNormal Transformed Variance:		
Number of Samples per month for compliance monitoring:	1	
Autocorrelation factor ( $\rho_e$ ) (use 0 if unknown):	0	
OUTPUT		
E(X) =	1.0000	
V(X) =	0.000	
VARn	0.0000	
MEANn=	0.0000	
VAR(Xn)=	0.000	lb/day
<b>Maximum Daily Effluent Limit:</b>	<b>1.0</b>	<b>0.00</b>
<b>Average Monthly Effluent Limit:</b>	<b>1.0</b>	<b>0.00</b>
	1	1

Date

Pollutant ( $\mu\text{g/L}$ )

ln(Pollutant conc)

#NUM!

Instructions: Enter data with yellow fields and red text.

## Spread of a Plume from a Point Source in a River with Boundary Effects from the Shoreline

Based on the method of Fischer et al. (1979) with correction for the effective origin of effluent.

INPUT	
1. Effluent Discharge Rate (cfs):	6.70
2. Receiving Water Characteristics Downstream From Waste Input	
Stream Depth (ft):	0.90
Stream Velocity (fps):	1.72
Channel Width (ft):	114.22
Stream Slope (ft/ft) or Manning roughness "n":	0.007
0 if slope or 1 if Manning "n" in previous cell:	0
3. Discharge Distance From Nearest Shoreline (ft):	0
4. Location of Point of Interest to Estimate Dilution	
Distance Downstream to Point of Interest (ft):	300
Distance From Nearest Shoreline (ft):	0
5. Transverse Mixing Coefficient Constant (usually 0.6):	0.6
6. Original Fischer Method (enter 0) or Effective Origin Modification (enter 1)	0
OUTPUT	
1. Source Conservative Mass Input Rate	
Concentration of Conservative Substance (%):	100.00
Source Conservative Mass Input Rate (cfs*%):	670.00
2. Shear Velocity	
Shear Velocity based on slope (ft/sec):	0.449
Shear Velocity based on Manning "n" (using Prasuhn equations 8-26 and 8-54 assuming hydraulic radius equals depth for wide channel):	
Darcy-Weisbach friction factor "f":	#N/A
Shear Velocity from Darcy-Weisbach "f" (ft/sec):	#N/A
Selected Shear Velocity for next step (ft/sec):	0.449
3. Transverse Mixing Coefficient (ft <sup>2</sup> /sec):	0.241
4. Plume Characteristics Accounting for Shoreline Effect (Fischer et al., 1979)	
C <sub>o</sub>	3.82E+00
x'	3.23E-03
y' <sub>o</sub>	0.00E+00
y' at point of interest	0.00E+00
Solution using superposition equation (Fischer eqn 5.9)	
Term for n= -2	0.00E+00
Term for n= -1	1.05E-134
Term for n= 0	2.00E+00
Term for n= 1	1.05E-134
Term for n= 2	0.00E+00
Upstream Distance from Outfall to Effective Origin of Effluent Source (ft)	#N/A
Effective Distance Downstream from Effluent to Point of Interest (ft)	300.00
x' Adjusted for Effective Origin	3.23E-03
C/C <sub>o</sub> (dimensionless)	9.92E+00
Concentration at Point of Interest (Fischer Eqn 5.9)	3.79E+01
Unbounded Plume Width at Point of Interest (ft)	36.746
Unbounded Plume half-width (ft)	18.373
Distance from near shore to discharge point (ft)	0.00
Distance from far shore to discharge point (ft)	114.22
Plume width bounded by shoreline (ft)	18.37
RESULTS	
<b>Approximate Downstream Distance to Complete Mix (ft)</b>	<b>37,103</b>
<b>Theoretical Dilution Factor at Complete Mix</b>	<b>26.204</b>
<b>Calculated Flux-Average Dilution Factor Across Entire Plume Width</b>	<b>4.215</b>
<b>Calculated Dilution Factor at Point of Interest</b>	<b>2.641</b>